**MA 109 — College Algebra** Fall 2008
EXAM 4 12/11/2008

**Name:** _____ **Sec.:** _____

Do not remove this answer page — you will turn in the entire exam. You have two hours to do this exam. No books or notes may be used. You may use a graphing calculator during the exam, but NO calculator with a Computer Algebra System (CAS) or a QWERTY keyboard is permitted. Absolutely no cell phone use during the exam is allowed.

The exam consists of multiple choice and short answer questions. Record your answers on this page. For each multiple choice question, you will need to fill in the box corresponding to the correct answer. For example, if (a) is correct, you must write

[a] [b] [c] [d] [e]

Do not circle answers on this page, but please do circle the letter of each correct response in the body of the exam. It is your responsibility to make it CLEAR which response has been chosen. You will not get credit unless the correct answer has been marked on both this page and in the body of the exam.

**GOOD LUCK!**

**1.** [a] [b] [c] [d] [e]

**2.** [a] [b] [c] [d] [e]

**3.** [a] [b] [c] [d] [e]

**4.** [a] [b] [c] [d] [e]

**5.** [a] [b] [c] [d] [e]

**6.** [a] [b] [c] [d] [e]

**7.** [a] [b] [c] [d] [e]

**8.** [a] [b] [c] [d] [e]

**9.** [a] [b] [c] [d] [e]

**10.** [a] [b] [c] [d] [e]

**11.** [a] [b] [c] [d] [e]

**12.** [a] [b] [c] [d] [e]

**13.** [a] [b] [c] [d] [e]

**14.** [a] [b] [c] [d] [e]

**15.** [a] [b] [c] [d] [e]

**16.** [a] [b] [c] [d] [e]

**17.** [a] [b] [c] [d] [e]

**18.** [a] [b] [c] [d] [e]

**19.** [a] [b] [c] [d] [e]

**20.** [a] [b] [c] [d] [e]

**For grading use:**

| | |
|---|---|
| **Total** | |
| | **(out of 100 pts)** |

**Name:**_____

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**Multiple Choice Questions**

*Show all your work on the page where the question appears.*
*Clearly mark your answer both on the cover page on this exam*
*and in the corresponding questions that follow.*

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1. Let $r(x) = \dfrac{x+3}{x-5}$. Find the asymptotes of $r$.

   **Possibilities:**

   (a) The vertical asymptote is $x = 5$ and the horizontal asymptote is $y = 1$.
   (b) The vertical asymptote is $x = -3$ and the horizontal asymptote is $y = 1$.
   (c) The vertical asymptote is $x = -3$ and the horizontal asymptote is $y = 5$.
   (d) The vertical asymptote is $x = 1$ and the horizontal asymptote is $y = 5$
   (e) The vertical asymptote is $x = 5$ and the horizontal asymptote is $y = -3$.

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2. The line $x = -5$ is a vertical asymptote of $y = \dfrac{1}{(x+5)^2}$. Determine the behavior of the graph near this asymptote.

   **Possibilities:**

   (a) $y \to \infty$ as $x \to -5^+$ and $y \to \infty$ as $x \to -5^-$.
   (b) $y \to \infty$ as $x \to -5^+$ and $y \to -\infty$ as $x \to -5^-$.
   (c) $y \to -\infty$ as $x \to -5^+$ and $y \to -\infty$ as $x \to -5^-$.
   (d) $y \to -\infty$ as $x \to -5^+$ and $y \to \infty$ as $x \to -5^-$.
   (e) $y \to 0$ as $x \to -5^+$ and $y \to 0$ as $x \to -5^-$.

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3. Find the domain and range of $y = \ln(x-6)$.

   **Possibilities:**

   (a) Domain: $(-\infty, \infty)$ Range: $(6, \infty)$
   (b) Domain: $(-\infty, \infty)$ Range: $[6, \infty)$
   (c) Domain: $(6, \infty)$ Range: $(-\infty, \infty)$
   (d) Domain: $[6, \infty)$ Range: $(-\infty, \infty)$
   (e) Domain: $(-\infty, \infty)$ Range: $(-\infty, \infty)$

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4. A ball is thrown in the air. After $t$ seconds, the height of the ball, in feet, is given by

$$h(t) = -5t^2 + 10t + 37$$

When does the ball reach its maximum height?

**Possibilities:**

(a) 6 sec
(b) 52 sec
(c) 37 sec
(d) 42 sec
(e) 1 sec

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5. Which of the following statements are true?

(I) $\ln(e^{500}) = 500$

(II) $\log(a - b) = \dfrac{\log(a)}{\log(b)}$ for all positive $a$ and $b$.

(III) $\log(ab) = \log(a) + \log(b)$ for all positive $a$ and $b$.

**Possibilities:**

(a) Only (II) and (III) are true.
(b) Only (III) is true.
(c) Only (I) and (III) are true.
(d) Only (I) is true.
(e) (I), (II), and (III) are all true.

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6. Let $f(x) = 2x^2 + 7$. Find $\dfrac{f(x+h) - f(x)}{h}$.

**Possibilities:**

(a) $-4x - 2h$
(b) $\dfrac{2h^2 + 7}{h}$
(c) $2h^2 + 7$
(d) $\dfrac{4xh + 2h^2 + 14}{h}$
(e) $4x + 2h$

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7. Carol invests $4000 at an interest rate of 4% per year compounded monthly, find the amount of the investment at the end of 15 years. Round your answer to the nearest cent.

**Possibilities:**

(a) $6404.13

(b) $4204.73

(c) $7281.21

(d) $7356.57

(e) $4162.97

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8. Solve.

$$\ln(x-5) = 6$$

**Possibilities:**

(a) $e^5 + 6$

(b) $e^6 + 5$

(c) $e^5 - 6$

(d) $e^6 - 5$

(e) No solutions

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9. The number of bacteria in a culture is modeled by the function $n(t) = 60e^{0.3t}$ where $t$ is measured in hours. When will the number of bacteria reach 3500? Round your answer to the nearest hundredth of an hour.

**Possibilities:**

(a) About 13.55 hours

(b) About 4.07 hours

(c) About 71.53 hours

(d) About 5.89 hours

(e) About 14.88 hours

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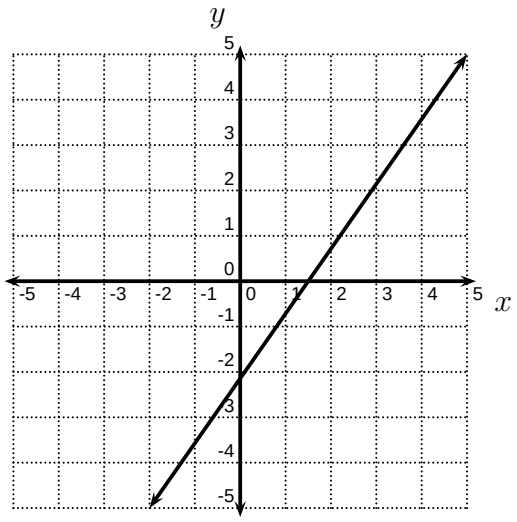
10. Find the slope of the line.




**Possibilities:**

(a) 7/10
(b) -7/10
(c) 17/7
(d) -10/7
(e) 10/7

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11. Let $f(x) = x^2 - 7$. Find the average rate of change of $f(x)$ between $x = 2$ and $x = 4$.

**Possibilities:**

(a) $-12$
(b) $6$
(c) $-6$
(d) $12$
(e) $1/6$

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12. Solve the inequality.

$$(x + 5)(x - 7) > 0$$

**Possibilities:**

(a) $(-\infty, -5) \cup (7, \infty)$
(b) $(-5, 7)$
(c) $(-\infty, \infty)$
(d) $(-\infty, -5] \cup [7, \infty)$
(e) $[-5, 7]$

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13. What quantity, $x$, of a 30% acid solution must be mixed with a 55% acid solution to produce 2500 mL of a 47% solution?

**Possibilities:**

(a) 900 mL

(b) 700 mL

(c) 800 mL

(d) 600 mL

(e) 500 mL

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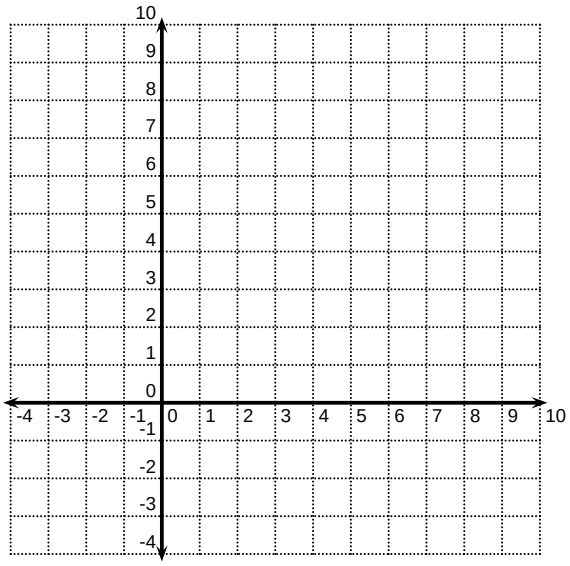
14. Find the **area** of the parallelogram ABCD with vertices $\mathrm{A}(-3,-2)$, $\mathrm{B}(2,-2)$, $\mathrm{C}(5,5)$, and $\mathrm{D}(0,5)$.




**Possibilities:**

(a) $35/2$ units

(b) $10 + 2\sqrt{58}$ units

(c) $35$ units

(d) $30$ units

(e) $24$ units

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15. Find an equation for the line that is parallel to $y = \dfrac{2}{3}x + 7$ and contains the point (3,23).

**Possibilities:**

(a) $y = -\dfrac{2}{3}(x-3) - 23$

(b) $y = \dfrac{2}{3}(x-3) + 23$

(c) $y = -\dfrac{3}{2}(x-3) - 23$

(d) $y = \dfrac{2}{3}(x-3) - 23$

(e) $y = -\dfrac{3}{2}(x-3) + 23$

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16. Find all of the zeros of $P(x) = x^3 - 10x^2 + 27x - 18$.

**Possibilities:**

(a) $-6, 1, 3$

(b) $1, 6, 7$

(c) $-6, -3, -1$

(d) $3, 6, 7$

(e) $1, 3, 6$

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17. Joe the Plumber charges a \$75 service fee plus \$65 per hour. If the total bill was \$400, how many hours did Joe work?

**Possibilities:**

(a) 7 hours

(b) 4 hours

(c) 6 hours

(d) 3 hours

(e) 5 hours

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18. Which of the following statements are true?

(I) If $P(x) = 3x^3 + x - 27x^2 - 9$, then $P(10) = 0$.

(II) $(10, 0)$ is an $x$-intercept on the graph of $y = 3x^3 + x - 27x^2 - 9$.

(III) The remainder of the division problem $\dfrac{3x^3 + x - 27x^2 - 9}{x - 10}$ is zero.

(IV) $(x - 10)$ is a factor of $3x^3 + x - 27x^2 - 9$.

**Possibilities:**

(a) Only (I) and (II) are true.

(b) Only (III) and (VI) are true.

(c) Only (I) and (III) are true.

(d) (I), (II), (III), and (IV) are all true.

(e) None of (I), (II), (III), and (IV) are true.

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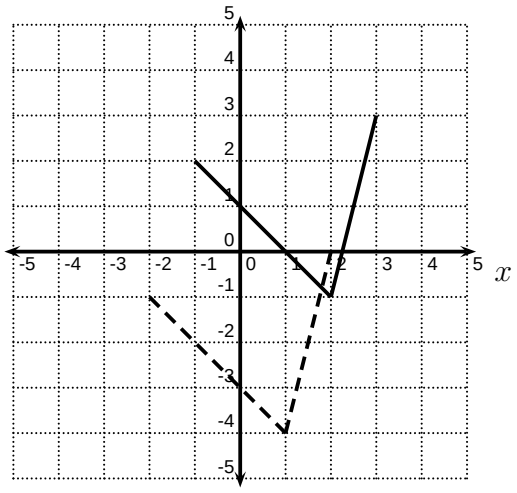
19. In the picture below, the graph of $y = f(x)$ is the solid graph, and the graph of $y = g(x)$ is the dashed graph. Find a formula for $g(x)$.




**Possibilities:**

(a) $g(x) = f(x+1) + 3$

(b) $g(x) = f(x-3) + 1$

(c) $g(x) = f(x+1) - 3$

(d) $g(x) = f(x-1) - 3$

(e) $g(x) = f(x+3) + 1$

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20. Let $h(x) = (2x+1)^5$. Find functions $f(x)$ and $g(x)$ such that $h(x) = f(g(x))$.

**Possibilities:**

(a) $f(x) = x^5$ and $g(x) = 2x + 1$

(b) $f(x) = x^5 + 1$ and $g(x) = 2x$

(c) $f(x) = 2x + 1$ and $g(x) = x^5$

(d) $f(x) = 2x$ and $g(x) = x^5 + 1$

(e) $f(x) = (2x+1)^3$ and $g(x) = (2x+1)^2$

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## Formula Sheet:

**Compound Interest:** If a principal $P$ is invested at an interest rate $r$ for a period of $t$ years, then the amount $A(t)$ of the investment is given by:

$$A(t) = P\left(1 + \frac{r}{n}\right)^{nt} \quad \text{(if compounded } n \text{ times per year)}$$

$$A(t) = P\,e^{rt} \quad \text{(if compounded continuously).}$$

**Exponential Growth Model** If $n_0$ is the initial size of a population that experiences **exponential growth**, then the population $n(t)$ at time $t$ increases according to the model:

$$\boxed{n(t) = n_0 e^{rt}}$$

where $r$ is the relative rate of growth of the population (expressed as a proportion of the population).

**Radioactive Decay Model:** If $m_0$ is the initial mass of a radioactive substance with half-life $h$, then the mass $m(t)$ remaining at time $t$ is modeled by the function:

$$\boxed{m(t) = m_0 e^{-rt}}$$

where $r = \dfrac{\ln 2}{h}$.

**Change of Base Formula:** Let $a$ and $b$ be two positive numbers with $a, b \neq 1$. If $x > 0$, then:

$$\boxed{\log_b x = \frac{\log_a x}{\log_a b}}$$